

What Is Claimed Is:

1. A method for making a silver-containing particulate product involving processing of a flowing aerosol stream, the method comprising the steps of:

5 introducing said aerosol stream into a reactor when said aerosol stream is a first aerosol flow including first droplets suspended in a carrier gas, with said first droplets including a silver-containing precursor material;

10 removing, in said reactor, liquid from said first droplets and forming particles including silver from said silver-containing precursor;

removing said aerosol stream, as a second aerosol flow including said particles, from said reactor;

15 said first aerosol flow characterized as including greater than about 0.5 liter per hour of said first droplets at a droplet loading of greater than about 0.083 milliliters of said first droplets per liter of said carrier gas, said first droplets having an average size and a size distribution such that said particles have a weight average size of from about 0.1 20 micron to about 4 microns with at least about 75 weight percent of said particles being smaller than about twice said average size.

2. The method of Claim 1, wherein:

25 said aerosol flow includes greater than about 2 liters per hour of said droplets.

3. The method of Claim 1, wherein:

said first aerosol flow includes greater than about 5 liters per hour of said first droplets.

4. The method of Claim 1, wherein:

30 said first aerosol flow includes greater than about 10 liters per hour of said first droplets.

5. The method of Claim 1, wherein:

said first aerosol flow includes greater than about 40 liters per hour of said first droplets.

6. The method of Claim 1, wherein:

    said first aerosol flow has a droplet loading of greater than about 0.083 milliliters of said first droplets per liter of carrier gas.

5     7. The method of Claim 1, wherein:

    said first aerosol flow has a droplet loading of greater than about 0.167 milliliters of said first droplets per liter of carrier gas.

8. The method of Claim 1, wherein:

10    said first aerosol flow has a droplet loading of greater than about 0.333 milliliters of said first droplets per liter of carrier gas.

9. The method of Claim 1, wherein:

15    said first aerosol flow has a droplet loading of greater than about 0.833 milliliters of said first droplets per liter of carrier gas.

10. The method of Claim 1, wherein:

    said first aerosol flow includes said first droplets at a density of larger than about  $5 \times 10^6$  of said first droplets per 20 cubic centimeter of said first aerosol flow.

11. The method of Claim 1, wherein:

    said first aerosol flow includes said first droplets at a density of larger than about  $1 \times 10^7$  of said first droplets per cubic centimeter of said first aerosol flow.

25    12. The method of Claim 1, wherein:

    said particles have a weight average size of smaller than about 3 microns.

13. The method of Claim 1, wherein:

    said particles have a weight average size of smaller than 30 about 2 microns.

14. The method of Claim 1, wherein:

    said particles have a weight average size of from about 0.8 micron to about 2 microns.

15. The method of Claim 1, wherein:

5 said particles have a weight average size of from about 0.2 micron to about 0.8 micron.

16. The method of Claim 1, wherein:

10 said particles have a size distribution such that at least about 90 weight percent of said particles are smaller than about twice said average size.

17. The method of Claim 1, wherein:

15 said particles have a density, as measured by helium pycnometry, of greater than about 90% of theoretical density.

18. The method of Claim 1, wherein:

20 said particles are substantially spheroidal.

19. The method of Claim 1, wherein:

25 said first droplets have a size distribution such that at least about 80 weight percent of said first droplets are smaller than about 10 microns in size.

20. The method of Claim 1, wherein:

30 said first droplets have a weight average size of from about 1 micron to about 5 microns.

21. The method of Claim 20, wherein:

25 said first droplets have a size distribution such that no greater than about 25 weight percent of said first droplets are larger than about twice the weight average size of said first droplets.

22. The method of Claim 1, wherein:

30 the method further comprises, prior to said step of introducing said aerosol stream into said reactor, generating said aerosol stream, including ultrasonically energizing a liquid-containing flowable medium from which generated droplets are released and sweeping said generated droplets away from said flowable medium with said carrier gas, said generated droplets comprising at least a portion of said first droplets; and

35 during said sweeping of said generated droplets away from said flowable medium, said carrier gas being delivered from a plurality of gas delivery outlets of a gas delivery system, with

5        said plurality of gas delivery outlets being positioned to direct different portions of said carrier gas to sweep away generated droplets released from different portions of said liquid-containing medium, thereby distributing said carrier gas to promote effective sweeping away of said generated droplets from said different portions of said liquid-containing medium.

23. The method of Claim 1, wherein:

10        the method further comprises, prior to said step of introducing said aerosol stream into said reactor, concentrating said aerosol stream, including removing carrier gas from said aerosol such that, following the step of concentrating, said aerosol stream has a higher loading of droplets per unit volume of carrier gas than prior to the step of concentrating.

15        24. The method of Claim 23 wherein:

      during said step of concentrating, droplet loading in said aerosol stream per unit volume of said carrier gas is increased by a factor of greater than about 2.

20        25. The method of Claim 23 wherein:

      during said step of concentrating, droplet loading in said aerosol stream per unit volume of said carrier gas is increased by a factor of greater than about 5.

25        26. The method of Claim 1, wherein:

      the method further comprises, prior to said step of introducing said aerosol stream into said reactor, subjecting said aerosol stream to classifying by size, including removing from said aerosol stream a first portion of droplets, including larger-size droplets, and retaining in said aerosol stream a second portion of droplets, including smaller-size droplets.

30        27. The method of Claim 26, wherein:

      the cut point of classification between said first portion of droplets and said second portion of droplets is smaller than about 10 microns.

28. The method of Claim 26, wherein:

the cut point of classification between said first portion of droplets and said second portion of droplets is smaller than about 5 microns.

29. The method of Claim 26, wherein:

5 said first portion of droplets comprises no greater than about 20 weight percent of the total of said first portion of droplets and said second portion of droplets.

30. The method of Claim 1, wherein:

10 said reactor comprises a furnace at elevated temperature, and, in said reactor, said liquid is removed from said first droplets of said first aerosol flow by evaporation of said liquid.

31. The method of Claim 30 wherein:

15 residence time of said aerosol stream in a heated zone of said reactor is shorter than about 4 seconds.

32. The method of Claim 31, wherein:

said residence time is shorter than about 2 seconds.

33. The method of Claim 31, wherein:

said residence time is shorter than about 1 second.

34. The method of Claim 30, wherein:

20 said aerosol stream, in said reactor, attains a maximum average stream temperature of from about 900°C to about 1300°C.

35. The method of Claim 30, wherein:

25 said aerosol stream, in said reactor, attains a maximum average stream temperature of from about 950°C to about 1200°C.

36. The method of Claim 30, wherein:

said aerosol stream, in said reactor, attains a maximum average stream temperature of from about 950°C to about 1100°C.

37. The method of Claim 1, wherein:

30 the method further comprises, after said step of removing said aerosol stream from said reactor, cooling said particles, including flowing said aerosol stream through a cooling conduit while introducing into said cooling conduit a cooling gas that mixes with and cools said particles.

38. The method of Claim 37, wherein:

5 said cooling gas is introduced into said cooling conduit in a manner such that a buffer of said cooling gas forms adjacent a wall of said cooling conduit between said wall and said particles, thereby separating said particles from said wall to reduce thermophoretic losses of said particles to said wall.

39. The method of Claim 37, wherein:

10 said cooling conduit includes a perforated wall perforated with openings through which said cooling gas enters said cooling conduit.

40. The method of Claim 39, wherein:

15 said perforated wall of said conduit extends substantially about the entire circumference of said cooling conduit such that said cooling gas is introduced radially into said conduit through holes of said perforated wall around substantially the entire circumference of said cooling conduit.

41. The method of Claim 40, wherein:

20 said cooling gas has a radial velocity entering into said conduit that is larger than a thermophoretic velocity of said particles toward said perforated wall.

42. The method of Claim 1, wherein:

said particles include a first material phase comprising said silver; and

25 the method further comprises, after said step of forming said particles, forming a second material phase on said particles, said second material phase being compositionally different from said first material phase, whereby multi-phase particles are prepared including both of said first material phase and said second material phase.

30 43. The method of Claim 42, wherein:

said second material phase is substantially free of silver.

44. The method of Claim 42, wherein:

said second material phase comprises a coating substantially covering said particles.

45. The method of Claim 43, wherein:  
said coating has an average thickness of thinner than about  
100 nanometers.

5 46. The method of Claim 43, wherein:  
said coating has an average thickness that is thinner than  
about 25 nanometers.

10 47. The method of Claim 42, wherein:  
the step of forming said second material phase includes  
physical vapor deposition of said second material phase on said  
particles.

15 48. The method of Claim 47, wherein:  
said physical vapor deposition includes deposition from a  
vapor phase comprising at least one of copper and gold.

49. The method of Claim 42, wherein:  
the step of forming said second material phase includes  
chemical vapor deposition of said second material phase on said  
particles.

20 50. The method of Claim 49, wherein:  
said chemical vapor deposition includes reaction of at  
least one metal-containing compound selected from the group  
consisting of an inorganic compound, metal organic, and an  
organometallic.

25 51. The method of Claim 49, wherein:  
said chemical vapor deposition includes reaction of at  
least one coating precursor selected from the group consisting  
of silanes, metal formates, metal acetates, metal oxalates,  
metal carboxylates, metal alkyls, metal aryls, metal alkoxides,  
metal ketonates, metal amides, metal hydrides, metal halides,  
and combinations thereof.

30 52. The method of Claim 42, wherein:  
said second material phase comprises at least one of  
silica, alumina, titania, zirconia, yttria, copper, gold,  
platinum, molybdenum, tungsten, an oxide of copper, an oxide of  
bismuth, an oxide of neodymium, an oxide of calcium, an oxide of

magnesium, an oxide of barium, an oxide of strontium, and an oxide of tin.

53. The method of Claim 42, wherein:

5 said second material comprises at least one of a silicate, a titanate, a zirconate, an aluminate, a borate, a niobate, and a tantalate.

54. The method of Claim 53, wherein:

10 said second material phase comprises a titanate of at least one of barium, strontium, neodymium, calcium, magnesium and lead.

55. The method of Claim 1, wherein:

15 said silver-containing precursor is a first precursor and said aerosol stream also includes a second precursor containing a second component that is other than silver; and

20 said particles are multi-phase particles comprising a first material phase including silver from said first precursor and a second material phase including said second component from said second precursor.

56. The method of Claim 55, wherein:

25 said second material phase comprises an oxide material.

57. The method of Claim 55, wherein:

30 said second material phase comprises a ceramic material.

58. The method of Claim 55, wherein:

35 said second material phase comprises at least one of silica, alumina, titania, zirconia, yttria, copper, gold, platinum, molybdenum, tungsten, an oxide of copper, an oxide of bismuth, an oxide of neodymium, an oxide of calcium, an oxide of magnesium, an oxide of barium, an oxide of strontium and an oxide of tin.

30 59. The method of Claim 55, wherein:

35 said second material phase includes at least one of a borate, a titanate, a zirconate, a silicate, an aluminate, a niobate and a tantalate.

60. The method of Claim 59, wherein:

1 said second material phase comprises a titanate of at least one of barium, strontium, neodymium, calcium, magnesium and lead.

61. The method of Claim 55, wherein:

5 said first precursor is in solution in liquid of said first droplets; and

said second precursor comprises precursor particles held within said first droplets.

62. The method of Claim 61, wherein:

10 said precursor particles are smaller than about one micron.

63. The method of Claim 62, wherein:

said precursor particles are smaller than about 0.5 micron.

64. The method of Claim 62, wherein:

said precursor particles are smaller than about 0.3 micron.

15: 65. The method of Claim 62, wherein:

said precursor particles are smaller than about 0.1 micron.

66. The method of Claim 62, wherein:

said precursor particles are of colloidal size and are present in said first droplets in a colloidal suspension.

20 67. The method of Claim 55, wherein:

both said first precursor and said second precursor particles are in solution in liquid of said first droplets.

68. The method of Claim 55, wherein:

25 said particles comprise said second material phase in an interior portion of said particles and said first material phase about the outer surface of said particles.

69. The method of Claim 55, wherein:

30 said particles comprise said second material phase as a coating about the surface of a core comprising said first material phase.

70. The method of Claim 1, wherein:

said silver-containing precursor is a first precursor and said aerosol includes a second precursor containing a second metal that is other than silver; and

5 said silver and said second metal are present in said particles as an alloy.

71. The method of Claim 70, wherein:

10 said second metal is selected from the group consisting of palladium, nickel, copper, platinum, molybdenum, tungsten, tantalum, aluminum, gold, indium, lead, tin, and bismuth.

72. The method of Claim 70, wherein:

said alloy comprises greater than about 50 weight percent silver.

73. The method of Claim 70, wherein:

15 said alloy comprises greater than about 70 weight percent silver.

74. The method of Claim 70, wherein:

said second metal is palladium.

75. The method of Claim 74, wherein:

20 said metallic phase comprises from about 30 weight percent to about 70 weight percent palladium and from about 30 weight percent to about 70 weight percent silver.

76. The method of Claim 74, wherein:

25 said metallic phase comprises from about 10 weight percent to about 30 weight percent palladium and from about 90 weight percent to about 70 weight percent silver.

77. A method for making silver-containing particles, the method comprising the steps of:

generating an aerosol including droplets suspended in a carrier gas, the generating comprising sweeping away with said carrier gas said droplets as said droplets are released from a reservoir of an ultrasonically energized flowable medium, said flowable medium comprising a liquid and a silver-containing precursor.

removing at least a portion of said liquid from at least a portion of said droplets of said aerosol and forming particles including silver from said silver-containing precursor;

wherein, during said step of generating said aerosol, said carrier gas being delivered from a plurality of gas delivery outlets of a gas delivery system, with each of said plurality of gas delivery outlets being positioned to direct a different portion of said carrier gas to sweep away a different portion of said droplets released from a different portion of said flowable medium, thereby distributing said carrier gas to promote effective sweeping away of said droplets from different portions of said flowable medium to form said aerosol.

78. The method of Claim 77, wherein:

a plurality of ultrasonic transducers underlie and are ultrasonically coupled with said flowable medium such that each of said ultrasonic transducers ultrasonically energizes a different portion of said flowable medium in said reservoir.

79. The method of Claim 78, wherein:

there is a protective coating on said ultrasonic transducers to prevent direct contact between said flowable medium and transducer material of said ultrasonic transducer.

80. The method of Claim 77, wherein:

said ultrasonic transducers are ultrasonically coupled with said flowable medium via an ultrasonically transmissive separator, disposed between said ultrasonic transducers and said

flowable medium, to prevent said flowable medium from contacting said ultrasonic transducers.

81. The method of Claim 80, wherein:

5 said ultrasonic transducers are ultrasonically coupled with said separator via an ultrasonically transmissive fluid, other than said flowable medium, located between said ultrasonic transducers and said ultrasonically transmissive separator.

82. The method of Claim 81, wherein:

10 said ultrasonically transmissive fluid flows between said ultrasonic transducers and said separator to cool said ultrasonic transducers during operation.

83. The method of Claim 78, wherein:

15 said plurality of transducers includes at least 9 transducers.

84. The method of Claim 78, wherein:

20 said plurality of transducers includes at least 25 transducers.

85. The method of Claim 78, wherein:

25 said plurality of transducers includes at least 40 transducers.

86. The method of Claim 78, wherein:

20 said plurality of transducers includes at least 100 transducers.

87. The method of Claim 78, wherein:

25 there being at least one of said gas outlets per each one of said transducers.

88. The method of Claim 78, wherein:  
said plurality of transducers are mounted in an array on a  
single mounting plate.

89. The method of Claim 78, wherein:  
5 during said generating step, greater than about 25  
milliliters per hour of said droplets are swept away to form  
said aerosol per each of said ultrasonic transducers.

90. The method of Claim 78, wherein:  
10 during said generating step, greater than about 50  
milliliters per hour of said droplets are swept away to form said  
aerosol per each of said ultrasonic transducers.

91. The method of Claim 78, wherein:  
15 during said generating step, greater than about 100  
milliliters per hour of said droplets are swept away to form  
said aerosol per each of said ultrasonic transducers.

92. The method of Claim 77, wherein:  
each of said gas delivery outlets is located above a  
different portion of said flowable medium.

93. The method of Claim 77, wherein:  
20 said flowable medium includes atomization cones, each  
overlying one of ultrasonic transducers, with troughs located  
between said atomization cones;  
said gas delivery outlets being located above said troughs  
and adjacent to said atomization cones, such that carrier gas  
25 exiting said gas outlets is directed toward said atomization  
cones to sweep away said droplets as said droplets are released  
from said atomization cones.

94. The method of Claim 93, wherein:  
30 at least a portion of at least one of said gas outlets is  
vertically lower than the top of one of said atomization cones  
at which gas exiting said at least one of said gas outlets is  
directed, whereby at least a portion of said carrier gas exits  
from said at least one of said gas outlets vertically lower than  
said top of said one of said atomization cones.

95. The method of Claim 78, wherein:  
exiting from each of said gas delivery outlets is a jet of  
said carrier gas, said jet being directed at an atomization cone  
of said flowable medium.

5 96. The method of Claim 95, wherein:  
said jet of said carrier gas is substantially horizontally  
directed.

97. A silver-containing particulate product, the particulate product comprising:

substantially spheroidal particles having a weight average size of from about 0.1 micron to about 4 microns, having a size distribution such that at least about 90 weight percent of such particles are smaller than twice said weight average size and having a metallic phase including greater than about 50 weight percent silver, said metallic phase including a mean crystallite size of greater than about 50 nanometers.

10 98. The particulate product of Claim 97, wherein:

said metallic phase includes greater than about 70 weight percent silver.

99. The particulate product of Claim 97, wherein:

said silver in said metallic phase is in the form of an alloy with a second metal, said second metal selected from the group consisting of palladium, nickel, copper, platinum, molybdenum, tungsten, tantalum, aluminum, gold, indium, lead, tin and bismuth.

100. The particulate product of Claim 97, wherein:

20 said second metal comprises palladium.

101. The particulate product of Claim 97, wherein:

said particles have a weight average size of smaller than about 3 microns.

102. The particulate product of Claim 97, wherein:

25 said particles have a weight average size of smaller than about 2 microns.

103. The particulate product of Claim 97, wherein:

said particles have a weight average size of from about 0.5 micron to about 2 microns.

30 104. The particulate product of Claim 97, wherein:

said particles have a density, as measured by helium pycnometry, that is greater than about 90% of theoretical density.

105. The particulate product of Claim 97, wherein:

1  
said particles are comprised substantially entirely of said  
metallic phase.

106. The particulate product of Claim 97, wherein:

5 said particles are substantially single crystals of said  
metallic phase.

107. A multi-phase silver-containing particulate product, the particulate product comprising:

substantially spheroidal particles having a density, as measured by helium pycnometry, of greater than about 80% of theoretical, having a weight average size of from about 0.1 micron to about 4 microns and having a size distribution such that at least about 90 weight percent of said particles are smaller than twice said weight average size, said particles including a first material phase being metallic and comprising silver and said particles also including a second material phase being substantially free of silver.

108. The multi-phase particulate product of Claim 107, wherein:

15 said first material phase comprises greater than about 50 weight percent of said particles.

109. The multi-phase particulate product of Claim 107, wherein:

said first material phase comprises greater than about 70 weight percent of said particles.

20 110. The multi-phase particulate product of Claim 107, wherein:

said first material phase comprises greater than about 90 weight percent of said particles.

25 111. The multi-phase particulate product of Claim 107, wherein:

said second material phase comprises less than about 30 weight percent of said particles.

112. The multi-phase particulate product of Claim 107, wherein:

30 said second material phase comprises less than about 10 weight percent of said particles.

113. The multi-phase particulate product of Claim 107, wherein:

5 said second material phase comprises greater than about 0.5 weight percent of said particles.

114. The multi-phase particulate produce of Claim 107, wherein:

5 said second material phase comprises greater than about 1 weight percent of said particles.

115. The multi-phase particulate product of Claim 107, wherein:

10 said first material phase is electrically conductive and said second material phase is dielectric.

116. The multi-phase particulate product of Claim 107, wherein:

said second material phase comprises an oxide material.

15 117. The multi-phase particulate product of Claim 107, wherein:

said second material phase comprises a ceramic material.

118. The multi-phase particulate product of Claim 107, wherein:

20 said second material phase comprises at least one of silica, alumina, titania, zirconia, copper, gold, platinum, molybdenum, tungsten, an oxide of copper, an oxide of bismuth, an oxide of neodymium, an oxide of calcium, an oxide of magnesium, an oxide of barium, an oxide of strontium and an oxide of tin.

25 119. The multi-phase particulate product of Claim 107, wherein:

said second material phase includes at least one of a borate, a titanate, a zirconate, a silicate, an aluminate, a niobate and a tantalate.

30 120. The multi-phase particulate product of claim 107, wherein:

said second material phase comprises a titanate.

121. The multi-phase particulate product of Claim 107, wherein:

5 said second material phase comprises a titanate of at least one of barium, strontium, neodymium, calcium, magnesium and lead.

122. The multi-phase particulate product of Claim 107, wherein:

10 said second material phase forms a coating around a core including said first material phase.

123. The multi-phase particulate product of Claim 122, wherein:

10 said coating substantially entirely surrounds said core.

124. The multi-phase particulate product of Claim 122, wherein:

125. said second material phase includes an organic material.

15 125.. The multi-phase particulate product of Claim 107, wherein:

126. said second material phase is dispersed throughout a matrix of said first material phase.

126. The multi-phase particulate product of Claim 107, wherein:

20 said second material phase is a support on which said first material phase is supported.

127. The multi-phase particulate product of Claim 107, wherein:

25 said first material phase includes an alloy of silver and a second metal selected from the group consisting of palladium, nickel, copper, platinum, molybdenum, tungsten, tantalum, aluminum, gold, indium, lead, tin and bismuth.

128. The multi-phase particulate product of Claim 127, wherein:

30 said second metal is palladium.

129. The multi-phase particles of Claim 128, wherein:  
said alloy comprises from about 10 weight percent to about  
70 weight percent palladium and from about 30 weight percent to  
about 90 weight percent silver.

5 130. The multi-phase particles of Claim 107, wherein:  
said first material phase has a mean crystallite size of  
larger than about 50 nanometers.

131. A method for making a silver-containing film, the method comprising the steps of:

5 applying a layer of paste to a substrate, said paste including particles dispersed in a carrier liquid, said particles including a metallic phase with greater than about 30 weight percent silver;

removing said carrier liquid from said layer of paste and forming on said substrate a densified layer including silver from said particles;

10 wherein, said particles being substantially spheroidal, having a weight average size of from about 0.1 micron to about 4 microns, having a size distribution such that at least about 90 weight percent of said particles are smaller than about twice said weight average size and having a mean crystallite size of 15 larger than about 50 nanometers.

132. The process of Claim 131, wherein:

said particles are comprised substantially of only said metallic phase.

133. The method of claim 131, wherein:

20 said metallic phase comprises a first material phase and said particles further comprise a second material phase being substantially free of silver.

134. The method of Claim 133, wherein:

25 said first material phase comprises greater than about 50 weight percent of said particles.

135. The method of Claim 133, wherein:

said second material phase comprises less than about 30 weight percent of said particles.

136. The method of Claim 133, wherein:

30 said first material phase is electrically conductive and said second material phase is dielectric.

137. The method of Claim 133, wherein:  
said substrate comprises a dielectric material for a capacitor and said second material phase of said particles also comprises said dielectric material.

5 138. The method of Claim 137, wherein:  
said dielectric material is a titanate.

139. The method of Claim 133, wherein:  
said second material phase comprises an oxide material.

10 140. The method of Claim 133, wherein:  
said second material phase comprises a ceramic material.

141. The method of Claim 131, wherein:  
said step of forming on said substrate a film including silver from said particles comprises heating said particles, on said substrate, to a temperature of greater than about 300°C.

15 142. The method of Claim 131, wherein:  
said method further comprises preparing a structure of stacked layers including a plurality of first layers including a dielectric material and second layers including said particles; and  
heating said structure to a temperature of greater than about 300°C to form a microelectronic structure including a plurality of silver-containing films, having silver from said particles, and including a plurality of dielectric layers, with at least one of said dielectric layers being between two adjacent of said silver-containing films.

20 25 143. The method of Claim 131, wherein:  
said particles including silver are first particles and the particulate product further compromises second particles, compositionally different from said first particles, including palladium.

144. An electronic device including a silver-containing layer adjacent to a ceramic layer, the device comprising:

5 a first layer including silver adjacent to a second layer including a ceramic material and being substantially in the absence of silver, said first layer being electrically interconnected with said second layer when said electronic device is operational in a electrical circuit;

10 wherein, said first layer further comprising said ceramic material and said first layer having been prepared from a paste having particles including substantially spheroidal multi-phase particles having a weight average size of from about 0.1 micron to about 4 microns, and having a size distribution such that greater than about 90 weight percent of said multi-phase particles are smaller than twice said weight average size, with 15 said multi-phase particles having a first material phase including said silver and a second material phase including said ceramic material.

145. The electronic device of Claim 144, wherein:

20 said ceramic material is a titanate.

146. The electronic device of Claim 144, wherein:

25 said ceramic material is a titanate of at least one of barium, strontium, neodymium, calcium, magnesium and lead.

147. The electronic device of Claim 144, wherein:

25 said electronic device comprises a capacitor including said first layer as an electrically conductive layer and said second layer as a corresponding dielectric layer.

148. The electronic device of Claim 144, wherein:

30 said first layer comprises less than about 10 weight percent of said ceramic material.

149. The electronic device of Claim 144, wherein:

35 said first layer comprises less than about 5 weight percent of said ceramic material.

150. The electronic device of Claim 144, wherein:

5 electrical contact between said first layer and said second layer being enhanced in comparison to electrical contact if said first layer had been made with a mixture of particles consisting essentially of first particles substantially entirely of only said first material phase and second particles substantially entirely of only said second material phase.

151. The electronic device of Claim 144, wherein:  
said multi-phase particles are first particles, and said  
paste further comprises second particles that are  
compositionally different than said first particles, said second  
particles including palladium.

152. A multi-layer capacitor including silver-containing electrically conductive layers, the capacitor comprising

5 a structure having stacked layers including a plurality of dielectric layers each including a dielectric material, with each dielectric layer being adjacent to and electrically interconnected with at least one of a plurality of electrically conductive layers including silver;

10 electrical contacts interconnected with said electrically conductive layers, said electrical contacts for connecting the capacitor in an electrical circuit when the capacitor is used;

said electrically conductive layers including said silver and at least some of said dielectric material;

15 wherein, at least a portion of said silver and said dielectric material in said electrically conductive layers being from substantially spheroidal multi-phase particles having a weight average size of from about 0.1 micron to about 4 microns, having a size distribution such that at least about 90 weight percent of said multi-phase particles are smaller than twice said weight average size and having a first material phase including said silver and a second material phase including said dielectric material.

20 153. The electronic capacitor of Claim 152, wherein:

said first material phase comprises an electrically conductive alloy including silver and a second metal.

25 154. The electronic capacitor of Claim 152, wherein:

said first electrical contact and said second electrical contact including silver from substantially spheroidal particles having a weight average size of from about 0.5 micron to about 2 microns, a size distribution such that at least about 90 weight percent of said silver-containing particles are smaller than with twice said weight average size, and including a mean crystallite size of larger than about 50 nanometers.